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For: RAISING AND LOWERING MECHANISM FOR BLINDS

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Attached please find the certified copy of the foreign application from which priority is claimed for the above-referenced application:

Country: Europe (EP)

Application No.: 02080464.7

Date: April 6, 2004

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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se referer à la description.)

Raising and lowering mechanism for blinds

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Die angehefteten Unterlagen stimmen mit der ursprünglich eingereichten Fassung der auf dem nächsten Blatt bezeichneten europäischen Patentanmeldung überein.

The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

Patentanmeldung Nr. **Patent application No.** **Demande de brevet n°**

02080464.7

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

R C van Dijk

RAISING AND LOWERING MECHANISM FOR BLINDS

The present invention relates to a raising and lowering mechanism for blinds, such as venetian blinds, roman shades, pleated blinds or the like. It includes a drive shaft and a driven cord spool mounted in keyed connection with the drive shaft, about which a lift cord can be wound in order to raise or lower the blind.

Such devices are known and described in e.g. GB 986,529, US 3,181,595 EP 0,554,212, CH 581,257 and DE 16269.

A rotatably driven spool is used to wind or unwind the lift cords of a blind. The spool is usually mounted in a keyed connection to a driven shaft. The shaft can be driven by a pulley and chain or by a motor (not shown). In order to ensure even, regular windings of the lift cord the spool can be provided with means to ensure that the spool is displaced longitudinally during rotation. Such a solution is described in GB 986,529, where the spool is provided with a screw thread which is in driven connection to a screw thread of one of the journals in which the spool rests.

Other solutions are the use of a circumferentially threaded spool as described in US 3,181,595. The cord winds in circumferential threads and the spool is transported by the threads in its longitudinal direction. The thread at the same time prevents overlapping windings. A drawback of such a spool was that different sizes of cords needed a differently configured spool thread. Also both these prior art solutions require relatively expensive machining of parts and are complicated in design and also require a lot of longitudinal space.

In order to solve the problem of transporting the windings in longitudinal direction without overlapping and without threading the spool, conical cord spools were proposed in a number of variations. These conical spools usually have a first end having a first diameter and a second end having a second diameter, the second diameter being smaller than the first. The spool includes a sloping portion where ,

the diameter of the spool reduces from the first diameter over a predetermined longitudinal length to the second smaller diameter. The cord is affixed to the small diameter end and is guided onto the spool at the large diameter end. Such spools are described in DE 16,269, CH 581, 257 and EP 0,554,212. The cord is wound around the spool starting at the first end of with the larger diameter and is transported along the sloping part to the second end of the spool with the smaller diameter by each next winding. The decrease in diameter of the spool in the sloping portion ensures the transport of the windings and the even, regular winding of the cord. EP 0,554,212 additionally includes a circumferential flange or shoulder means at the larger diameter end of the spool to ensure transport of the windings in longitudinal direction towards the small diameter end of the spool. Also all the conical spools have a possibly smooth surface on the spool, to reduce friction and to facilitate the sliding of the windings in longitudinal direction towards the smaller end.

It has proven difficult to design a conical cord winding spool which ensures good winding under all circumstances. The problem of the longitudinal transport of the windings was largely solved by the conical shape, the shoulder means and by providing a smooth surface. Nevertheless an additional problem has sometimes manifested itself. By using a conical shape and a smooth surface to ensure the longitudinal transport of the windings, the friction of the cord in the circumferential direction also became very low and was no longer sufficient to reduce the tension of the cord over the windings. So although a low friction in longitudinal or axial direction is desired, a too high tension of the cord in the circumferential direction of the cord spool adversely affects the transport of the lift cord in axial direction of the spool.

It has now been found that the use of longitudinally extending ribs on the spool solves this problem.

In accordance with this invention, it has been proposed to provide a cord spool for winding a lift cord for lifting and lowering a window covering, the cord spool including an elongated generally cylindrical body with a first longitudinal spool end and a second longitudinal spool end and a circumferential outer surface, wherein the circumferential outer surface having a plurality of generally parallel extending longitudinally extending ribs.

In one embodiment the ribs extend along the total length of the spool from the first spool end to the second spool end.

In another embodiment a first number of long ribs extend along the total length of the spool, and a second number of short ribs extend along a first longitudinal portion of the spool and are shorter than the long ribs, the first longitudinal spool portion starting at the first spool end and extending a part of the total length of the spool towards the second spool end. The long and short ribs can be alternatingly place about the circumference of the first portion of the spool.

In yet another embodiment the ribs are tapered being wider at the first spool end and progressively narrowing towards the second.

It can be advantageous if the short ribs extending only along the first spool portion have a stronger taper than the long ribs extending along the total length of the spool.

The cord spool of all previous embodiments can also be a conical spool including a first spool diameter at first spool end and a second spool diameter at the second spool, the first spool diameter being larger than the second spool diameter, and the diameter of the spool decreasing over the total length of the spool from first spool end to second spool end.

Another feature of the spool can be that the cord spool also includes a second spool portion extending towards the second spool end after the first spool portion, and the first spool is conical with a stronger taper than the second spool portion.

Additionally the length of the second spool portion can be longer than the length of the first spool portion.

The cord spool of all previous embodiments can also include a mounting means for rotably mounting the cord spool in a support means, and wherein the support means includes a camming surface adjacent the first spool end for moving a first winding of the cord about the spool direction away from the first end of the cord spool, such that a next winding will not overlap the first winding.

The spool of all previous embodiments can also includes at least one longitudinally extending slot in the second spool end adapted to receive a second end of the lift cord for attachement to the spool.

The spool of most previous embodiments can also include an end plug attachable to the second spool end and adapted to receive a second end of the lift cord for attachement to the spool.

The end plug of the cord spool can include a longitudinally extending cylindrical portion forming an extension to the cord spool.
The cylindrical portion of the end plug can be a conical portion having an increasing diameter extending away from the second spool end.

The invention also pertains to a lifting and lowering mechanism for a blind, including:
a rotatable drive shaft;
at least one lift cord;
and a cord spool for winding the at least one lift cord and mounted for rotation with the winding shaft, the cord spool having a first diameter end and a second diameter end, defining a conical circumferential winding surface therebetween for the cord;

wherein the cord spool has a plurality of longitudinally extending, radial ribs on the winding surface, which are located at least on the circumferential area adjoining the first diameter end.

Additionally the lifting and lowering mechanism can further include an end plug attached to the second diameter end to receive one end of the at least one lift cord.

The end plug can have a cylindrical portion forming an extension to the spool, but being without a taper or with a taper opposite to the spool.

The end plug can include a plurality of circumferentially distributed radial slots, each of which is adapted to receive an end of the at least one lift cord for attachement.

The lifting and lowering mechanism of the previous embodiments can further including a support for rotatably supporting the cord spool.

The support can include a camming surface adjacent the first diameter end of the cord spool for guiding the lift cord to be wound onto the spool.

Further aspects of the invention will be apparent from the detailed description below of a particular embodiment and the drawings thereof, in which:

Figure 1, is a front view of a first embodiment of the blind lifting and lowering device of the invention;

Figure 2 is an exploded view of a first embodiment of the blind lifting and lowering device of the invention; and

Figures 3A-D is a perspective view of second, third, fourth and fifth embodiments of the cord spool of the blind lifting and lowering device of the invention.

Figures 1 and 2 show a first embodiment of the blind lifting and lowering device 1 of the invention. The device includes a generally conical cord spool 3 rotatably mounted in a support member 5 and comprising an end plug 7. The support member can be mounted in a head rail of a blind (not shown). The cord spool 3

can be driven to rotate in clockwise and counterclockwise directions in order to wind or unwind a lift cord 9. The cord spool 3 can be driven by a conventional drive shaft 11.

As shown in figure 1, the spool has a circumferential outer surface 13 including longitudinally extending ribs 15. The ribs 15 are longitudinally extending and parallelly spaced on the outer circumference of the spool to define the outer surface 13 for receiving the lift cord 9. The ribs 15 are preferably of general rectangular shape.

As shown in figure 2 the ribs 15 are distributed evenly about the circumference of the spool 3. Also in the longitudinal direction a first sloping section 17 of the spool 3 adjacent a first, right or larger diameter end 19 has the same number of ribs as a second section 21 of the spool 3 adjacent the second, left or smaller diameter end 23 of the spool 3. The second spool section 21 can be level, but if the spool 3 is produced by (injection) moulding, the second spool section 21 is preferably slightly sloped for reasons of moulding die design. The second spool section 21 is always more level than the first sloping section 17.
The ribs 15 provide for a relative narrow contacting surface for the lift cord windings, thus creating a reduced friction between the cord and spool in longitudinal direction of the spool and thereby facilitating the sliding movement of the cord windings towards the second smaller diameter end 23 of the spool. At the same time the longitudinal edges 25 of the individual ribs 15 provide for an enhanced friction between the cord and the spool in circumferential direction of the spool. This enhanced circumferential friction causes the cord tension in the windings of the cord to quickly reduce as the windings progress over the circumference of the spool and also creates a more evenly distributed cord tension in the initial windings 33.

The spool body 3 as shown in Figures 1 and 2 has a first, right, large diameter end 19, a first sloping portion 17, a level or very slightly sloping second portion 21

and a left, second, small diameter end 23 with a completely level or reversed sloping portion 95. The spool 3 is mounted in support member or carrier 5 at the large diameter end 19. The spool 3 has a relatively large diameter at the first diameter end 19 and a smaller diameter at the second end 23. The first sloping section 17 extends from the first end 19 in longitudinal direction of the spool to the second spool section 21. The beginning of the first spool section 17 coincides with the first spool end 19, the end of the first spool section 17 coincides with the beginning of the second spool section 21. The end of the second spool section 21 coincides with the second spool end 23 of the spool. The first spool section 17 is chosen to have a relatively steep slope and extends over a relatively short longitudinal portion of the spool 3. The first sloping section 17 is the section of the spool were the first cord windings 33 are formed and thus at that first section there is the largest risk of overlapping windings being created. The second spool section 21 of the spool 3 can extend over a longer portion of the spool than the first sloping section 17, and is of a lesser slope or level.

Extending longitudinally outward from the outer surface of the first end 19 of the spool 3 there is an annular mounting flange 37. A mounting ring 39 extends longitudinally and radially outward from the mounting flange 37. The mounting flange 37 and ring 39 are used to mount spool 3 on support member 5.

The support member 5 comprises a mounting side 40, a free side 41, a top 43, a bottom 45 and a front 47 and a rear side 49. A central opening 51 extends through the support member in longitudinal direction and rotatably accommodates the drive shaft 11. The support member 5 is a stationary part and is adapted to be mounted in a head rail of a window covering (not shown, but conventional). The bottom side 45 of the support member 5 comprises a horizontally extending base 53 and comprises a cord entrance opening 55 for guiding the lift cord 9 into the head rail (not shown) and towards the spool 3.

Extending longitudinally outwardly from the mounting side 40 of the support member 5 and co-extending with the spool is a cradle 57. When the spool 3 is mounted to the support member 5, the mounting ring 39 is rotatably carried by the cradle 57. Cradle 57 includes a semi -circular cradle base 59. Perpendicular to the cradle base 59 is radially inward extending cradle rim 61. An outer circumferential surface of mounting ring 39 rides rotatably on an inner semi-circular surface of cradle base 59 and the mounting ring 39 is axially retained by cradle rim 61.

As shown in figure 1 projecting from mounting side 40 of the support member 5 is a cord camming member 73. The cord camming member 73 is a semi-circular flange that projects longitudinally away from the mounting side 40 and is located radially outwardly away from the cradle base 59. The cord cam 73 extends longitudinally beyond the cradle base 59. The cord cam 73 has a front or start point 75, a middle bottom point 77 and a rear end point 79. The width of the cord cam is largest at its front and rear points 75,79 and smallest at the bottom point 77. The cam 73 thus has a pitch angle α relative to the lift cord 9 as it extends vertically down through cord entrance opening 55 of the support 5. The semi-circular shape of the cam 73 with the opposite start and end points 75,79 facilitates the right or left handed use of the support 5. The cord 9 can be guided on the spool by the pitch α of cam 73 from front or rear sides 47,49 of the support 5, while the cord guiding opening 55 in support base 53 is centrally located between front and rear sides of the support member.
The cord cam 73 extends at its front and rear points 75,79 longitudinally co-axial with the cord spool 3, at the large diameter end 19 of the cord spool 3 where the cord spool diameter is at its maximum. This means that the diameter of the semi-circular cord cam 73 is larger than the maximum diameter of the cord spool. Thus allowing the spool to rotate free from the cord cam. At the same time the radial distance between the inner surface of cord cam 73 and the outer circumferential

surface 13 of the spool 3, is substantially less than a single thickness of the lift cord 9. This prevents the lift cord 9 from moving between the cord cam and the spool surface.
The cam pitch angle α relative to the place of cord guiding opening 55 and to the cord spool 3 are such that the lift cord 9 is guided onto the spool as the spool rotates. The dimension from the lowest point of the cam to the highest should be about a single cord diameter.

In case the mounting ring has a diameter that is approximately the same as the diameter of the large diameter spool end, the cam and cradle of support member 5 can be integrally formed. Such a mounting ring 139 is shown in Figure 3A.

The end plug 7 can be inserted into the small diameter end 23 of the cord spool 3 in any convenient manner. End plug 7 includes a plug-in end 81 and a free end 83. Such a plug 7 can have external projecting short fingers 85 and detent ridges 82 on the plug-in end 81 and can be used allowing the plug 7 to be inserted and fixed to the spool 3. The spool has cutouts 87 complementary to the fingers 85 and retaining ridge 89 complementary to the detent ridges 82 at the small diameter end 23 of spool 3 as shown in figure 2, ensuring engagement with the spool. The plug can be inserted in incremental angular positions of e.g. 90 degrees apart allowing for some length adjustment of the lift cord attached thereto. The free end 83 of the end plug is provided with radial slots 91. The lift cord 9 can be attached with the a second cord end 93 to the end plug 7 by inserting it in one of the radial slots 91. The end plug 7 can have a longitudinal cylindrical portion 95 which can accommodate a number of windings 97 of the lift cord 9. No ribs are provided on the cylindrical portion 95 of the end plug 7. Ribs are only needed at the conical portion of the spool, there tension of the cord is present and thus friction should be direction determined, which is what the ribs accomplish. Length of the end plug is a determined by a compromise between

the space allowed in the head rail and height of the blind operated (i.e. the length of the cord to be wound).

In assembly the lift cord 9 with first cord end 99 is threaded upward through the headrail (not shown) and the cord guiding opening 55 in spool support 5 and attached with second cord end 93 to the cord spool 3. The downward extending first cord end 99 carries a window covering or a bottom rail thereof (not shown, but conventional). When the drive shaft 11 is driven to rotate the cord spool 3 (see fig. 1), the lift cord 9 will be wound around the spool 3. Since the cord is attached to the bottom rail of the blind, the blind will be raised. When the cord is unwound the window covering is lowered. Figure 1 shows a situation where the winding is only just started. As illustrated in Figure 1 there are in total 4 complete windings 97 around the spool.

Figure 3A-D shows several possible configurations of the ribs and their distribution along the spool. For like parts like referral numbers are used greater by 100, 200, 300 and 400.

Figure 3A shows a spool 103 including elongated ribs 115 extending from first, large diameter end 119 to second small diameter end 123. The long ribs 115 thus extend along a first sloping section of the spool 117 and also along a second spool section 121. This spool 103 of the second embodiment additionally includes a number of short ribs 116 that are placed between the long ribs 115 and only extend over a part of the total length of the spool body. As can be seen from the figure 3A the short ribs 116 extend only over the first section of the spool, the sloping section 117 where the cord windings are formed.

Figure 3B shows a spool 203 of a third embodiment. This spool 203 includes a large diameter end 219, a first spool section 217, a second spool section 221, and a small diameter end 223. The spool 203 also includes long ribs 215 that extend along the whole length of the spool body 203. The long ribs 215 are tapered and are narrower at the second small diameter end 223 of the spool than

they are at the larger diameter end 219 of the spool. Also at the large diameter end 219 of the spool 203 short and medium length ribs 216, 218 are positioned between the long ribs 215. The short ribs 216 are shorter in longitudinal direction than the medium ribs 218 , which in turn are shorter than the full length ribs 215. All the ribs are tapered and are wider at the large diameter end 219 of the spool 203 and taper as they extend towards the small diameter end 223 of the spool 203. The large diameter end 219 can be almost the same diameter as the small diameter end 223, and the first and second spool sections 217, 221 can also have the same slope.

Figure 3C shows a fourth embodiment of the spool 303. The ribs 315 are all tapered. The ribs 315 start very wide at the large diameter end 319 of the spool 303 where they are almost touching each other . But the taper is chosen such that the longitudinally extending rib edges 325 converge at an angle towards the smaller diameter end 323. The taper of the ribs 315 can be divided up into two zones, a sharp taper for the first section 317 of the spool 303 and a relatively flat taper at the second spool section 321 of the spool . Thus at the second spool section 321 of the spool 303 the ribs 315 seem to run almost parallel.

Figure 3D shows a fifth embodiment of the spool 403. The ribs are all short ribs 416 that extend from the large diameter end 419 along the first sloping spool section 417 only. The second spool section 421 extending towards the small diameter end 423 is shaped like a cylinder without ribs.

The effect of the distribution of the ribs as shown in figures 3A-3C is an alternative arrangement for ensuring enhanced sliding properties of the cord windings along a nearly level or level spool section 121, 221, 321 of the spool. Less ribs or narrower ribs due to tapering will cause less axial friction.

In a further embodiment the shape and dimensions of the ribs can be chosen such that they will approximate a circular section, and that the actual dimensions of the ribs are close to the cord diameter. This will keep the cord evenly

tensioned, so the cord will not show bends, caused by heat influence after having been spooled-up for a longer period of time. Also it may assist to have the first cord winding in close contact with a camming surface, in order to prevent the windings from crossing each other. Variation in number of ribs, sizes etc will work as well. Spoke-like ribs are also possible.

The ribs 15, 115, 116, 215, 216, 218, 315, 416 of the spool 10 can be shaped by making grooves in the circumferential surface of spool 10. Or a ribbed spool can be conveniently injection molded from a suitable plastics material.

As shown in figure 3B the end plug can be omitted and one or more radial slots 291 can be made in small diameter end 223 of the spool 203, in which the second cord end (not shown) can be inserted.

This invention is, of course, not limited to the above-described embodiments which may be modified without departing from the scope of the invention or sacrificing all of its advantages. In this regard, the terms in the foregoing description and the following claims, such as "longitudinal", "lateral", "inner", "outer", "right", "left", "top", "bottom", "downward", "front", "rear", "upper" and "lower", have been used only as relative terms to describe the relationships of the various elements of the control system of the invention for coverings for architectural openings. For example, kinematic inversions of the elements of the control systems, described above, are to be considered within the scope of the invention.

CLAIMS

1. A cord spool for winding a lift cord (9) for lifting and lowering a window covering,

the cord spool including an elongated generally cylindrical body (3, 103, 203, 303, 403) with a large diameter end (19, 119, 219, 319, 419) and a small diameter end (23, 123, 223, 323, 423) and a circumferential outer surface (13) of a given length extending therebetween

wherein the circumferential outer surface (13) having a plurality of generally parallelly extending longitudinal ribs (15,115, 116, 215, 216, 218, 315, 416).

2. The cord spool of claim 1 wherein,
the ribs (15, 115, 215, 315) extend along the entire given length of the outer surface (13) from the large diameter end (19, 119, 219, 319) to the small diameter end (23, 123, 223, 323).

3. The cord spool of claim 1 wherein
the ribs are short ribs (416) which extend only along a first longitudinal section (417) of the spool and, the first longitudinal section (417) starting at the large diameter end (419) and extending a part of the entire given length of the spool towards the small diameter end (423).

4. The cord spool of claim 1, wherein
a first number of long ribs (115, 215) extend along the entire given length of outer surface (13) of the spool, and a second number of short ribs (116, 216, 218) extend along a first longitudinal section (117, 217) of the spool and are shorter than the long ribs and the first longitudinal spool section (117, 217) starting at the large diameter end (119,219) and extending a part of the entire given length of the spool towards the small diameter end (123, 223).

5. The cord spool of claim 4, wherein, in the first spool section (117,217) the long and short ribs alternate about the circumference of the spool.

6. The cord spool of claims 1-5 wherein the ribs (215, 216, 218, 315) are tapered being wider at the large diameter end (219, 319) and progressively narrowing in the direction of the small diameter end (223, 323).

7. The cord spool of claim 4, 5 and 6 wherein the short ribs (116,216, 218) extending only along the first spool section (117, 217) have a stronger taper than the long ribs extending along the entire given length of the spool.

8. The cord spool of claims 1-7 further including , the cord spool 3 is a conical spool including a first spool diameter at the large diameter end (19, 119, 219, 319, 419) and a second spool diameter at the small diameter end (23, 123, 223, 323, 423), the first spool diameter being larger than the second spool diameter, and the diameter of the spool decreasing over the entire given length of the spool from first spool end to second spool end.

9. The cord spool of claim 8 further including, a first spool section (17,117,217,317,417) starting at the large diameter end (19,119,219,319,419) and extending a part of the entire given length of the spool towards the small diameter end (23,123,223, 323,423), a second spool portion (21, 121, 221, 321, 421) extending towards the small diameter end (23, 123, 223, 323, 423) after the first spool section (17,117,217,317,417), and the first spool section (17,117,217,317,417) is conical with a stronger taper than the second spool section.

10. The cord spool of claim 9 wherein, the length of the second spool section (21, 121, 221, 321, 421) is longer than the length of the first spool portion (17,217,317,417).

11. The cord spool of claims 1-10 wherein the large diameter end (19, 119, 219, 319, 419) includes a mounting means (37,39,137) for rotatably mounting the cord spool (3) in a support means (5), and wherein the support means (5) includes a camming surface (73) adjacent the large diameter end (19, 119, 219, 319, 419) for moving a first winding (33) of the cord (9) about the spool (3) in a direction away from the large diameter end ((19, 119, 219, 319, 419) of the cord spool, such that a next winding will not overlap the first winding.

12. The cord spool of claims 1-11 further including at least one longitudinally extending slot in the small diameter end (223) adapted to receive a second end (93) of the lift cord (9) for attachement to the spool.

13. The cord spool of claims 1-11 further including an end plug (7) attachable to the small diameter end (23, 123, 323, 423) and adapted to receive a second end (93) of the lift cord (9) for attachement to the spool.

14. The cord spool of claim 13 wherein, the end plug (7) has a longitudinally extending cylindrical portion (95) forming an extension to the cord spool.

15. The cord spool of claim 14 wherein, the cylindrical portion (95) of the end plug (7) is a conical portion having an increasing diameter extending away from the small diameter end (23, 123, 323, 423).

16. A lifting and lowering mechanism for a blind, including:
a rotatable drive shaft (11);
at least one lift cord (9);
and a cord spool (3) for winding the at least one lift cord (9) and mounted for rotation with the winding shaft (11), the cord spool having a large diameter end (19.,119,219,319,419) and a small diameter end (23, 123, 223, 323, 423), defining a conical circumferential winding surface (13) therebetween for the cord; wherein the cord spool (3) has a plurality of longitudinally extending, radial ribs (15, 115, 116, 215, 216,218, 315, 416) on the winding surface (13), which are located at least on the circumferential area adjoining the large diameter end (19,119,219,319,419).

17. The lifting and lowering mechanism of claim 16, further including an end plug (7) attached to the small diameter end (23) to receive one end (93) of the at least one lift cord (9).

18. The lifting and lowering mechanism of claim 17, wherein the end plug (7) has a cylindrical portion (95) forming an extension to the spool (3), but being without a taper or with a taper opposite to the spool.

19. The lifting and lowering mechanism of claims 17 or 18, wherein the end plug (7) has a plurality of circumferentially distributed radial slots (91), each of which is adapted to receive an end (93) of the at least one lift cord (9) for attachement.

20. The lifting and lowering mechanism of claims 16 -19, further including a support (5) for rotatably supporting the cord spool (3).

21. The lifting and lowering mechanism of claim 16, wherein the support (5) has a camming surface (73) adjacent the large diameter end (19,119,219,319,419) of the cord spool (3) for guiding the lift cord (9) to be wound onto the spool (3).

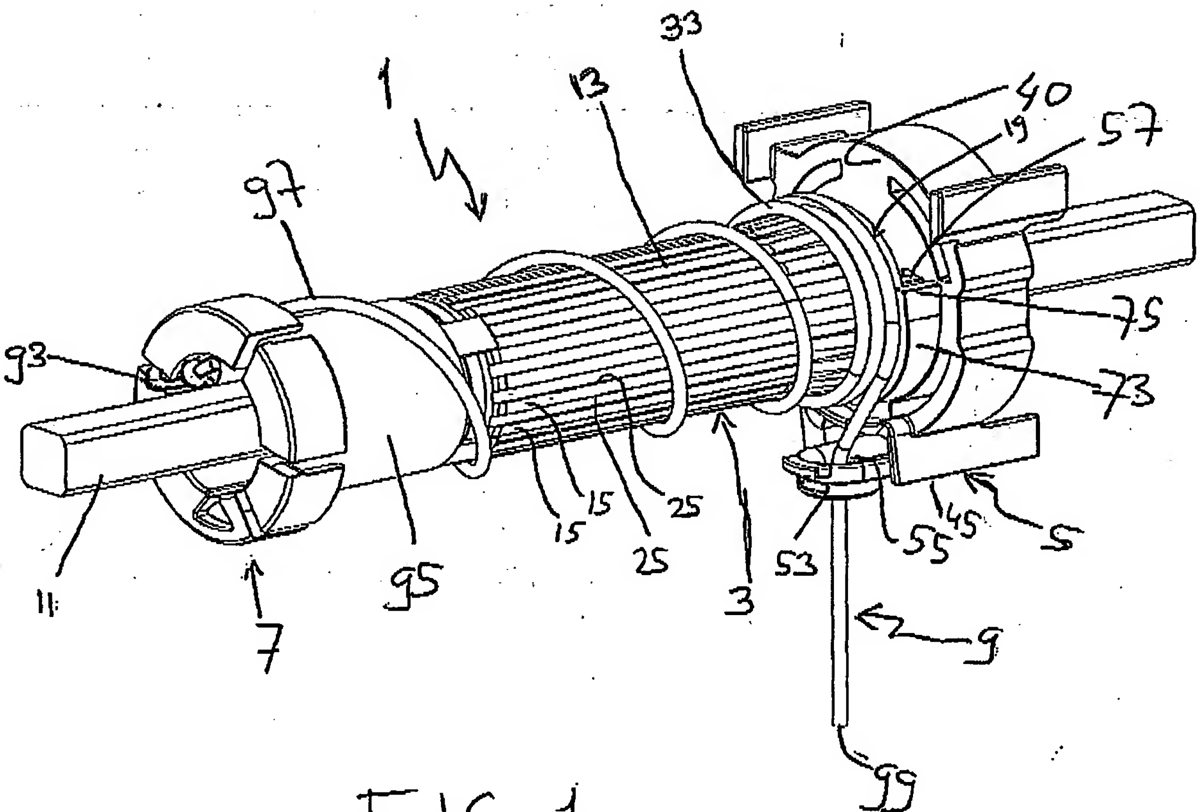

FIG 1

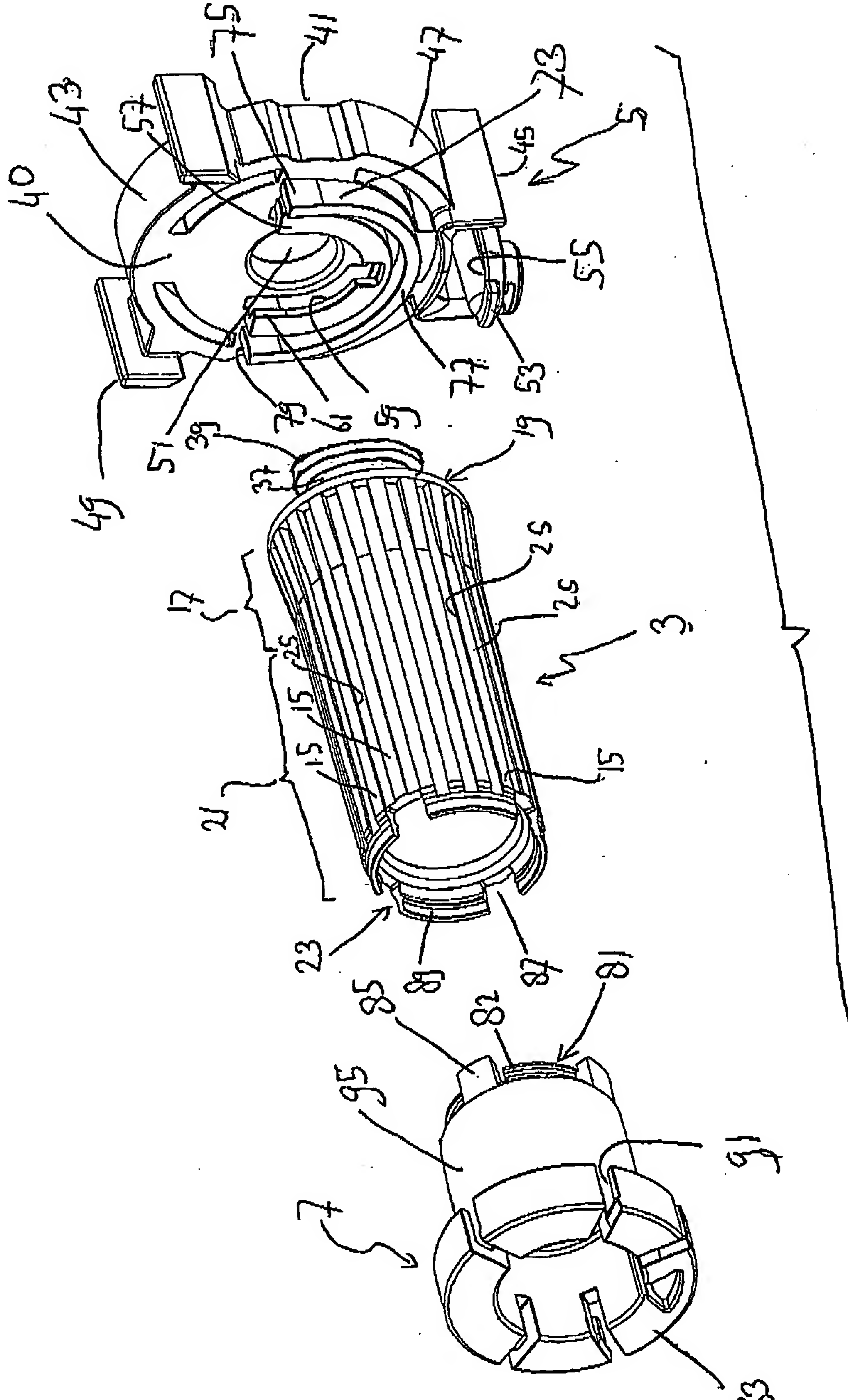
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FIG 2

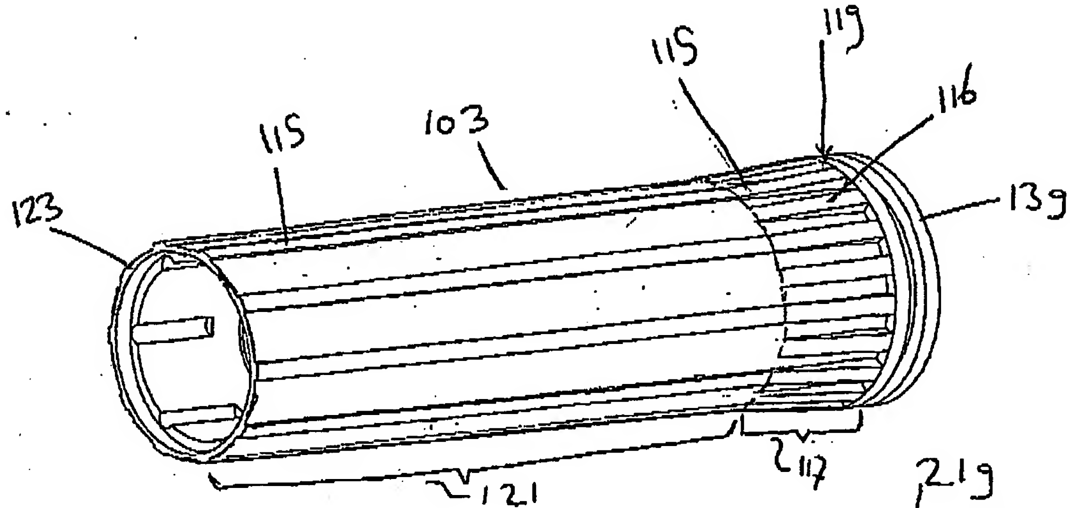

FIG 3A

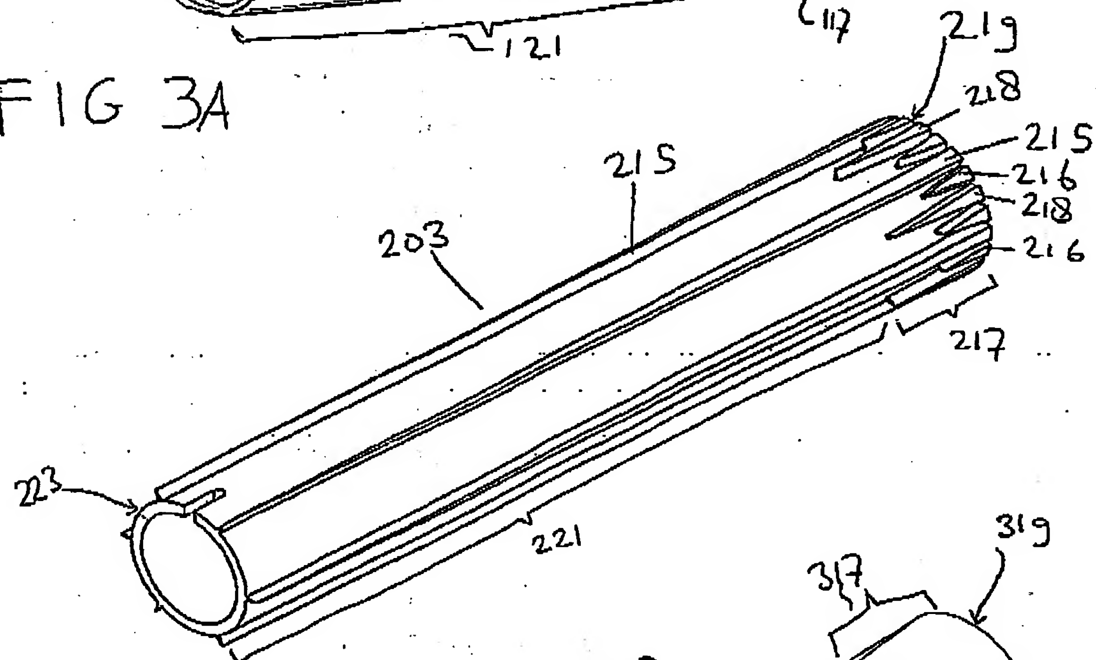

FIG 3B

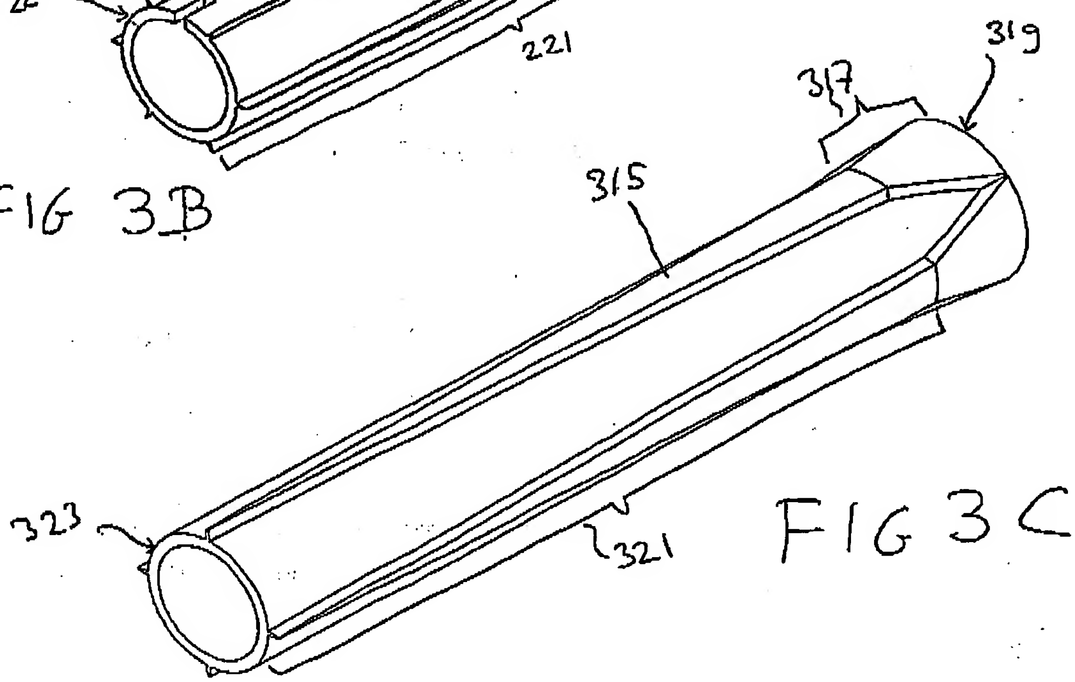

FIG 3C

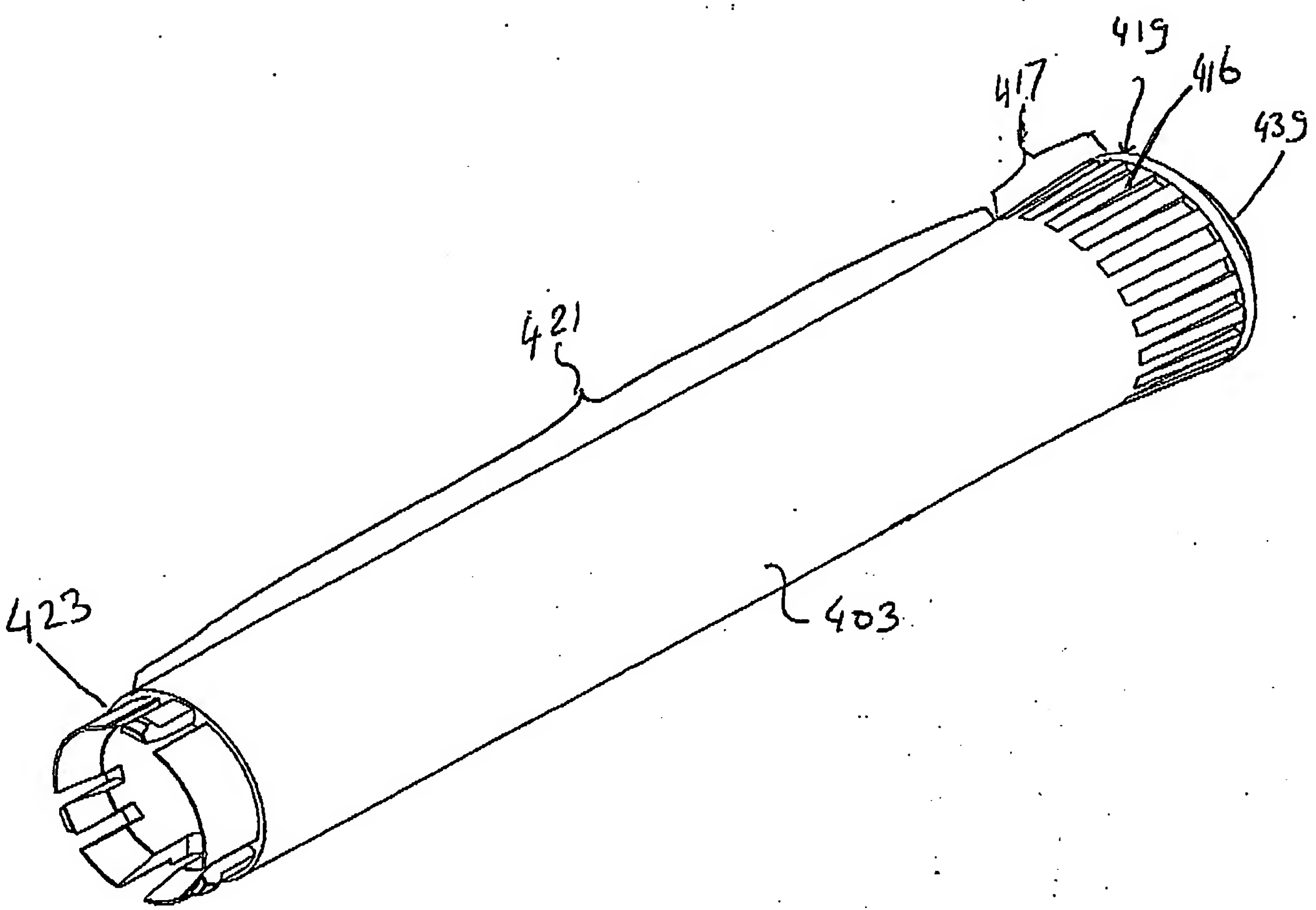

FIG 3D